NDIA 36th Gun and Ammo Symposium

Precision Electric Turret/M230 Gun System
A30CR Ammunition Fuzing Assumptions
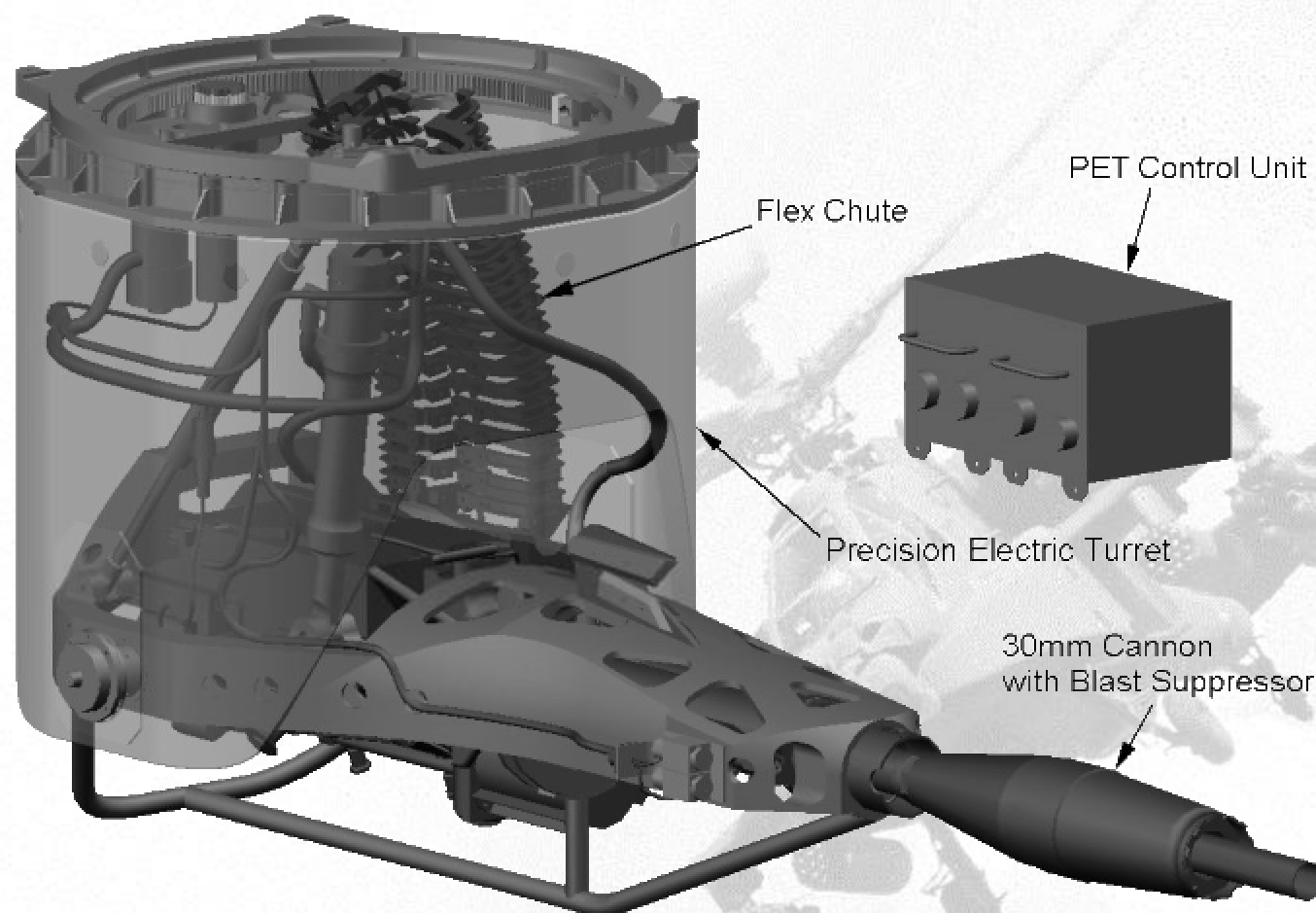
L. A. Mason

Thomas Bann

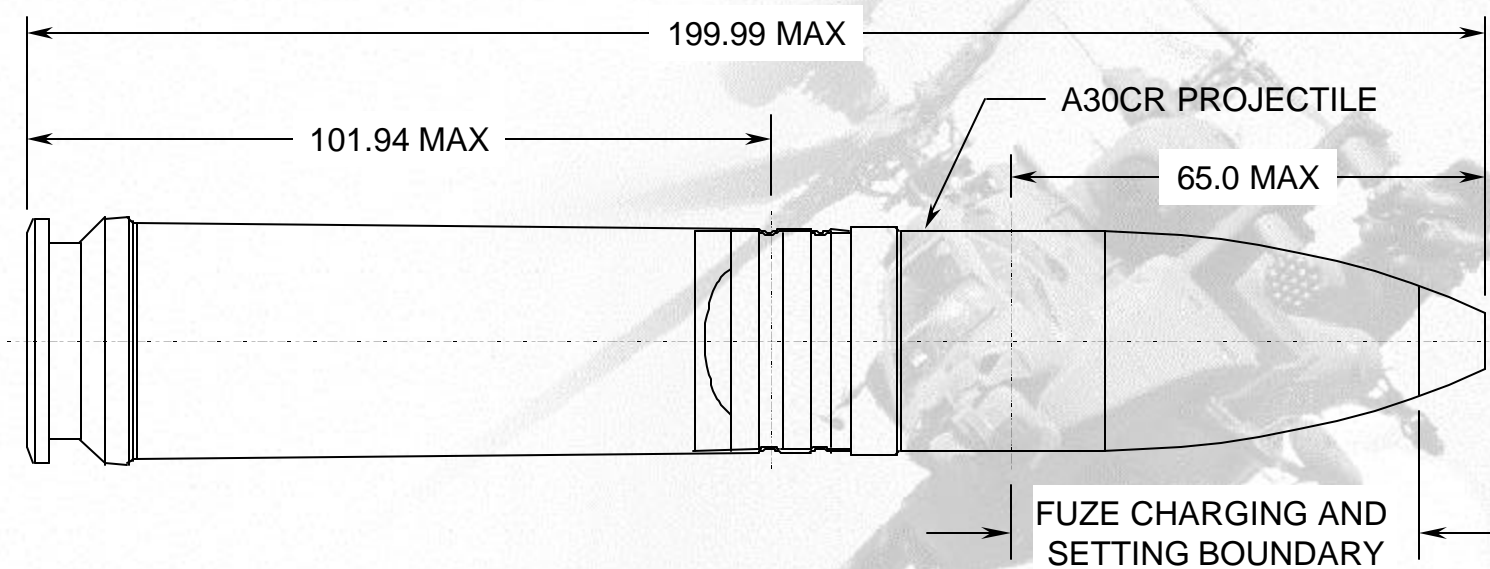The Boeing Company

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Flex Chute

PET Control Unit

Precision Electric Turret

30mm Cannon
with Blast Suppressor

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A30CR Round

FUZE SETTER INTERFACE COMPONENTS MUST BE LOCATED WHOLLY WITHIN AREA SHOWN

199.99 MAX

101.94 MAX

A30CR PROJECTILE

65.0 MAX

FUZE CHARGING AND
SETTING BOUNDARY

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A30CR Fuzing Methodology

Assumed Fuze Operating Modes/Configurations

- Point detonation
- Programmed Airburst
- Proximity Sensing (Passive)

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A30CR Fuze Data Options

Data words required for incorporation of Hybrid turns count / time methodology

- No. of Turns to given range

- Muzzle velocity correction?

- Correction for Barrel exit angle variation?

- Hybrid method using Time of flight

Data word length, accuracy, time

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Effect of Muzzle velocity Variation

Error Source   Error (m/s, 1 Sigma)

- Bias Error -
    - Ammunition lot-to-lot   4.3
    - Barrel-to-Barrel   3.0
    - Occasion-to-occasion   5.0
    - Total bias error (RSS)   7.2
- Random error -
    - Ammunition Rd.-to-Rd.   4.9 (Allowable - 10 m/s)
- Random error (corr. V_m)   25% of total error
- Muzzle velocity variation with temperature
    - Current Longbow Apache Weapons Processor model assumed
    - (Barrel thermal dynamics not included.)

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Turns Count Range and Altitude Errors
for +5 m/s V_m Error
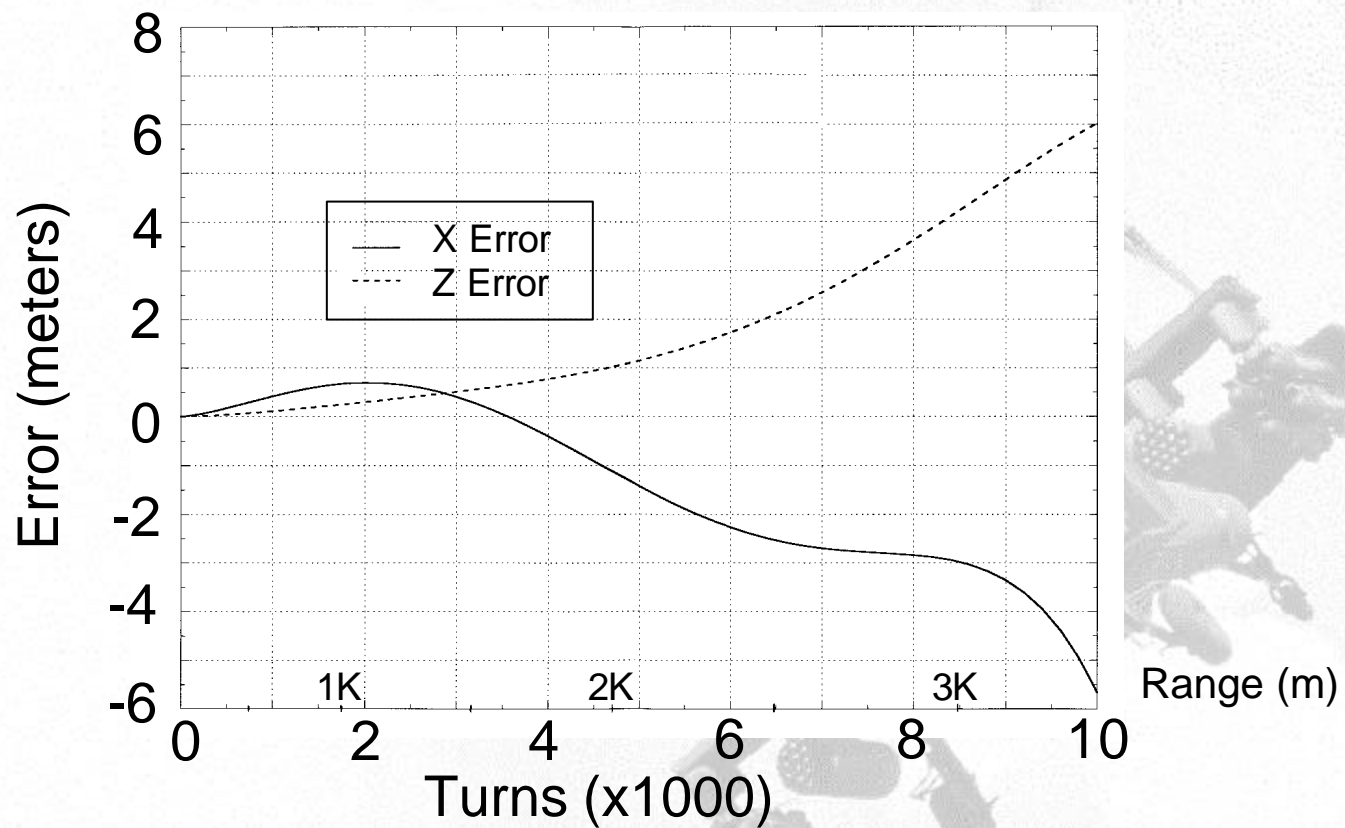
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Typical Errors Using Turns Count Method Without Muzzle Velocity Correction

Range (m)	Slant Range Error (m)
1000	4.78
2000	6.34
3000	7.09

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Range Error Using Turns Count Method Due to Barrel Exit Angle Variation

Range(m)	Angle Error	Turns/m	Range Error (m)
0	0	1.2112	(Nom.)
	-.01°	1.2094	N/A
	+.01°	1.2132	N/A
1000	-.01°	2.5783	1.000
	+.01°	2.5863	-1.108
2000	-.01°	3.3374	2.064
	+.01°	3.3477	-2.300
3000	-.01°	3.9700	3.144
	+.01°	3.9823	-3.457

Note: Assumed no altitude error.

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Error Budget Weighting Approach

Model	Bias (M)			Random (m)		
	1000	2000	3000	1000	2000	3000
T/C	3.96	11.02	25.92	3.01	5.71	11.02
TOF	4.71	9.95	23.95	3.23	5.93	11.14

Range (m)	T/C	TOF
0 - 1000	100%	0%
1001 - 1300	75%	25%
1301 - 1600	50%	50%
1601 - 2000	25%	75%
2001 - 3000	0%	100%

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Data Word Format (Turns Count Depicted)

SYNC MSB   LSB   PARITY

0.443
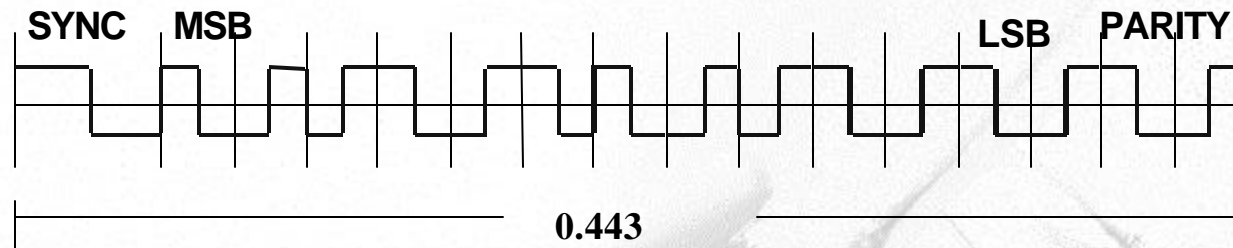
Resolution of each 14 bit data word transmitted at 38,400 Hz baud rate is:

- Turns count = 16,384 turns full scale, 1 turn resolution
- TOF = 16.384 seconds full scale, 0.001 seconds resolution
- Exit angle = 115.1917338 mr full scale, 0.007030745 mr resolution
- Muzzle velocity = 1638.4 m/sec full scale, 0.1 m/sec resolution

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A30CR Round

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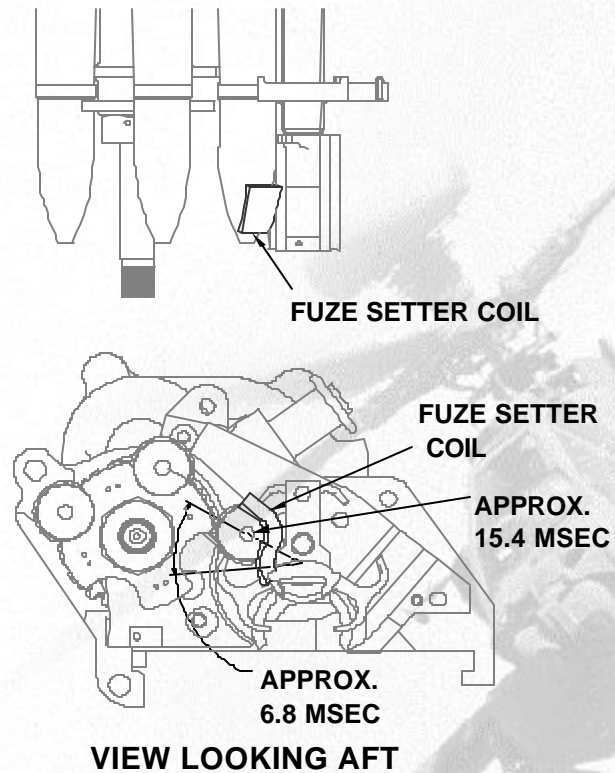
65.0 MAX

FUZE CHARGING AND
SETTING BOUNDARY
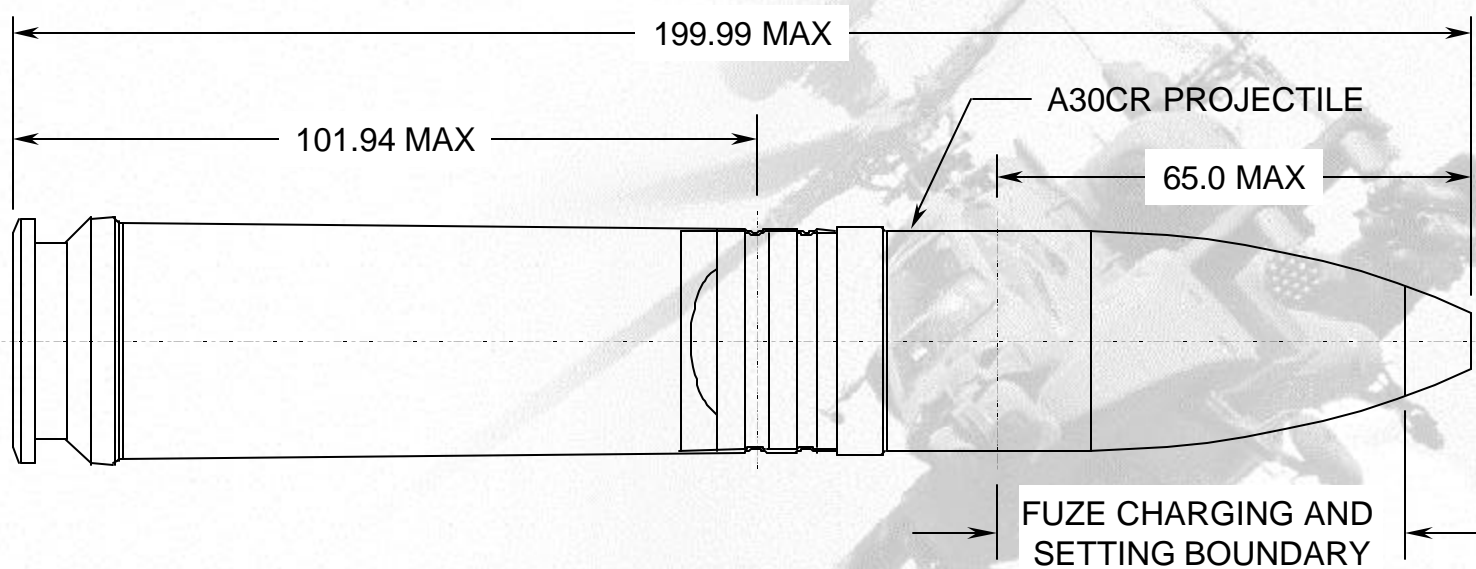
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Fuze Charging

- Fuze powered using ± 28 VDC, 5 +1/-0 amps using contact tang

- Minimum round charging resistance/impedance
  - 3.2 ohms

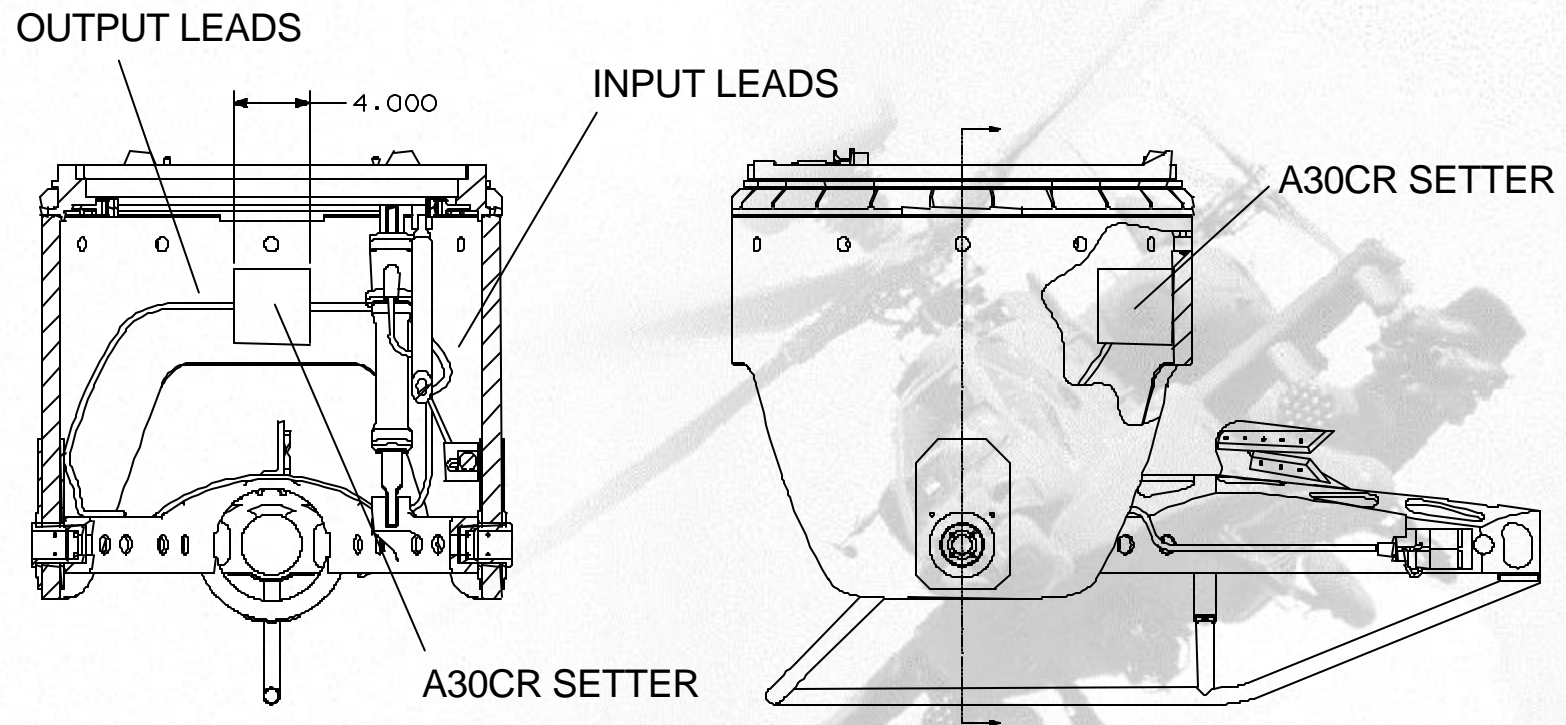- Coding coil driven by 15 VDC, 0.5 amps max.

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Fuze Setter Location Using M230 Chain Gun

FUZE SETTER COIL

FUZE SETTER
COIL

APPROX.
15.4 MSEC

APPROX.
6.8 MSEC

VIEW LOOKING AFT

A30CR Setter Placement

OUTPUT LEADS

4.000

INPUT LEADS

A30CR SETTER

A30CR SETTER

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A30CR Fuzing Summary

Conclusions

- Muzzle velocity correction desired to meet range/altitude error requirements
- Fuze timing module reduces errors due to barrel exit angle variations
- Hybrid TC/TOF method achieves best results
- Fuze setter can be integrated into M230 Gun
- Measured barrel exit angle required for M230 gun application